



## "Enhancing Problem-Solving and Analytical Thinking in High School Students for Educational Success"

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Date of Submission: 12-02-2025

Date of Acceptance: 24-02-2025

**Abstract:** In study aims to address the challenges faced by high school students, particularly in their inability to perform well in the Chemistry theory paper. Previous data shows that only 10 out of 63 students passed the exam. The research will focus on developing problem-solving and analytical thinking skills in students, using a combination of primary and secondary data as well as techniques derived from years of teaching experience. By implementing and testing these methods, the goal is to observe measurable improvements in student performance, particularly in upcoming exams. Data from class results will be analyzed to validate the effectiveness of the proposed methods.

**Key words:** Differential teaching methods, problem solving and analytical thinking skills.

### I. Introduction:

The pursuit of academic excellence is a key objective for high school learners, yet numerous barriers hinder their ability to achieve success. Among the most pressing issues is the struggle faced by students in performing well in the ISC Chemistry theory paper. As highlighted by previous data, only 10 out of 63 students were able to pass this exam, underscoring a significant need for interventions (NCRB, 2011). These statistics point to systemic problems in the students' ability to prepare effectively, including difficulties in comprehending complex topics, addressing misconceptions, and organizing their study strategies.

One of the key ways to address these challenges is by developing two crucial skills: problem-solving and analytical thinking. Problem-solving involves identifying and tackling the root cause of a problem, while analytical thinking enables students to break down problems and find logical, evidence-based solutions (Paul & Elder, 2013). By cultivating these skills, students can approach complex topics, not only in Chemistry but across various subjects, with a more structured and

critical mindset, helping them succeed in their academic pursuits (Jonassen, 2000).

To build these skills among high school learners, targeted teaching methods must be employed. One effective strategy involves introducing problem-solving and analytical thinking through subject-related questions. The role of the educator is paramount in this process, as trained teachers need to first demonstrate the application of these skills in solving problems. As students gain familiarity, they can practice on similar types of problems, which are then evaluated for feedback and improvement. This method, when employed consistently, can lead to a significant improvement in students' learning outcomes (Mayer, 2002).

The present research seeks to identify the primary issues hindering student performance in the Chemistry theory paper, while simultaneously developing targeted strategies to enhance their cognitive skills. Using primary and secondary data sources, this study will propose innovative teaching techniques informed by the extensive teaching experience of educators. Furthermore, the efficacy of these techniques will be rigorously tested, with the results analyzed to assess improvements in student performance.

This study will contribute to the growing body of literature on differential teaching methods and their impact on student success. By doing so, it will provide educators and students with valuable tools to overcome academic challenges, reigniting students' interest in subjects like Chemistry, where enthusiasm appears to be waning (Swartz & Perkins, 1990). Additionally, it highlights the need for a shift from rote memorization to active learning approaches that emphasize deep understanding and analytical reasoning.

**Objective of the study:** 1. Find ways to improve the below average learners in Chemistry. 2. Find ways to create interest for the subject chemistry among the learners.



## II. Literature Review:

Problem-solving is recognized as a process rather than a mere result (Keenland, 2001), encompassing a series of cognitive and procedural efforts aimed at overcoming challenges (Bloom & Niss, 1991). This process typically begins with recognizing the problem at hand (Fulya Oner Armagan, Safak Ulcinar Sagir, & Ayse Yalcin Celik, 2009). However, many traditional teaching methods that emphasize rote learning and repetitive drilling without a deep understanding of the subject matter hinder students' ability to solve problems effectively (Laddawan Burana & Chanyah Dahsah, 2016). In contrast, fostering critical thinking has been shown to significantly improve problem-solving skills, as students are better equipped to analyze problems and develop solutions (Elizabeth Yuriev, Som Naidu, Luke S. Schembri, & Jennifer L. Short, 2017).

The integration of technology in learning environments has also been highlighted as a means to enhance students' proficiency with scientific problem-solving, offering interactive tools that support experimentation and analysis (Carol R. Beal & Ronald H. Stevens, 2011). Additionally, teaching strategies that emphasize problem translation and the development of conceptual linkages between different topics have been shown to improve students' problem-solving performance (Tang Who Un, Lucille Lee Kam Wah, Goh Ngoh Khang, & Chia Lian Sai, 2000). Such instructional methods promote essential skills like data analysis, method selection, error awareness, and effective communication, which are vital for solving complex problems (Colin Wood, 2006).

A recurring theme in the literature is the necessity of developing students' problem-solving abilities through effective teaching practices and skills development. While multiple strategies such as scaffolding techniques and extended practice sessions are discussed, a critical aspect often overlooked is the role of effective revision strategies. Students may struggle with consolidating knowledge and applying problem-solving techniques during exams due to a lack of structured revision approaches. Thus, the research gap lies in developing and implementing revision techniques that not only reinforce core content but also strengthen students' problem-solving and analytical thinking abilities in preparation for assessments.

This literature review emphasizes the need to move beyond traditional methods and incorporate a holistic approach that includes technology, critical thinking, and effective revision strategies, all of which are essential for fostering deeper learning and

enhanced problem-solving skills. Addressing this gap could significantly contribute to improved academic performance, particularly in subjects like Chemistry, where students often face difficulties in theoretical applications.

**Research Gap:** Despite extensive research on teaching methods and problem-solving skill development, there is limited focus on effective revision strategies. Existing studies overlook how students can consolidate and apply problem-solving skills during exam preparation, especially in challenging subjects like Chemistry. Developing targeted revision techniques that reinforce both conceptual understanding and analytical thinking is crucial to improving student performance, particularly in high-stakes exams like the ISC Chemistry theory paper.

**Techniques to improve in chemistry:** To address the challenges faced by high school students in understanding and revising Chemistry, various teaching methodologies were applied:

**Dart Activity for Inorganic Chemistry:** Knowledge-based questions were taught using a worksheet with guided instructions, encouraging students to repeatedly read and understand the text, followed by problem-solving exercises.

**Mechanism-Based Organic Chemistry:** Students' prior knowledge of General Organic Chemistry (GOC) was assessed. Short revisions were provided, and organic reactions were explained with mechanisms, linking new concepts to prior knowledge.

**Concept-Focused Physical Chemistry:** Emphasis was placed on understanding concepts rather than memorizing formulas. Problems were discussed in class to clarify which formulas to apply, and memory aids were introduced for recall.

**Open Book Tests:** These tests encouraged students to use textbooks, helping them learn to link concepts and develop independent problem-solving skills.

**Enhanced Practical Learning:** Experiments were explained in detail, focusing on titration, salt analysis, and the reasoning behind chemical changes, creating a deeper understanding of practical Chemistry.

**Tarsia Puzzles for Revision:** Students created Tarsia puzzles for peer groups to revise chapters in an engaging way, promoting collaboration and deeper learning.

**Short Notes:** Students learned to condense key concepts on a single sheet for focused revision, refining the notes based on topics they struggled to recall.



**Mnemonics:** Mnemonics for organic reactions and key concepts across Chemistry were provided to aid memory retention.

**Topic Synopses:** Advance synopses and real-world applications of topics were shared to spark interest and contextualize learning.

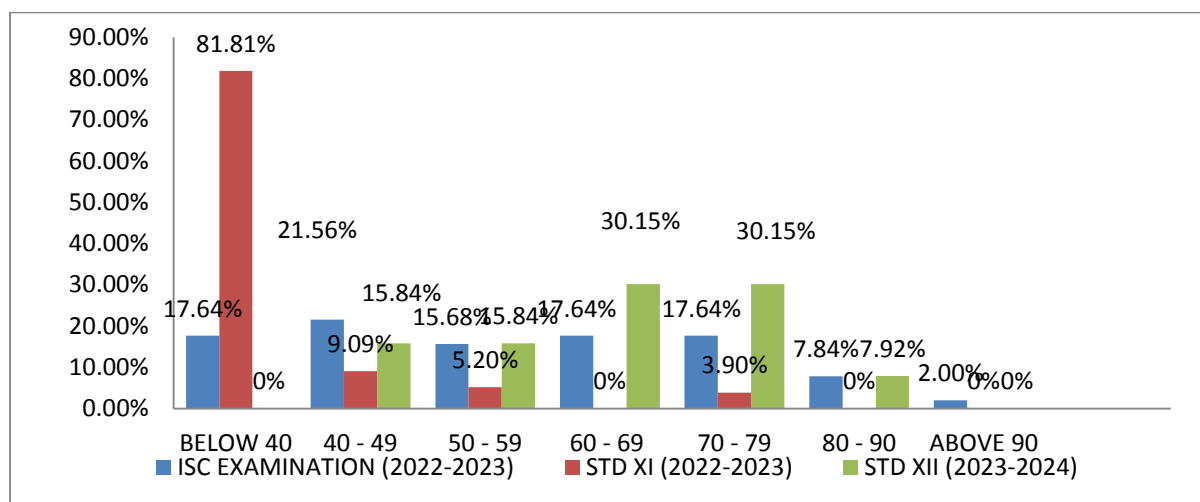
**Focused Tests and Revision:** Separate tests were conducted for physical, organic, and inorganic

Chemistry, with dedicated revision classes for Organic Chemistry, connecting concepts across chapters.

All these above mentioned techniques were used in one whole academic year and data in terms of the marks scored by the students in ISC examinations were collected.

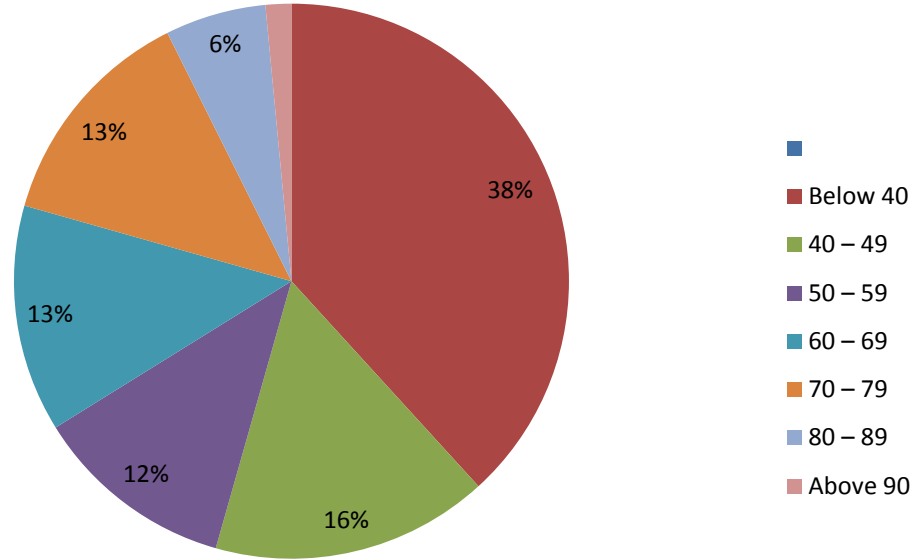
#### Data Analysis:

Range of marks	ISC examination Previous batch 2022 - 2023	Before using these techniques (Std XI Final term)	After using these techniques (ISC examination 2023 -2024)
Below 40%	26(38.23%)	63 (81.81%)	0(0%)
40 – 49%	11(16.17%)	7(9.09%)	10(15.84%)
50 – 59%	8(11.76%)	4(5.20%)	10(15.84%)
60 – 69%	9(13.23%)	0(0%)	19(30.15%)
70 – 79%	9(13.23%)	3(3.90%)	19(30.15%)
80 – 90%	4(5.88%)	0(0%)	5(7.92%)
Above 90	1(1.50%)	0(0%)	0

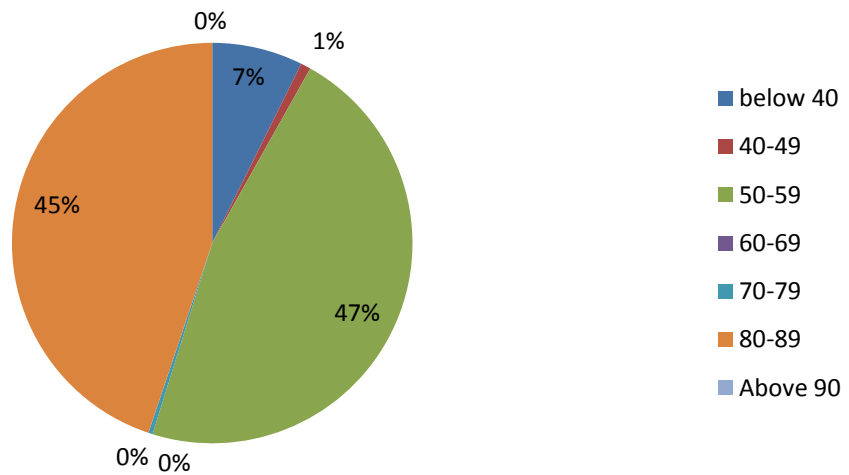


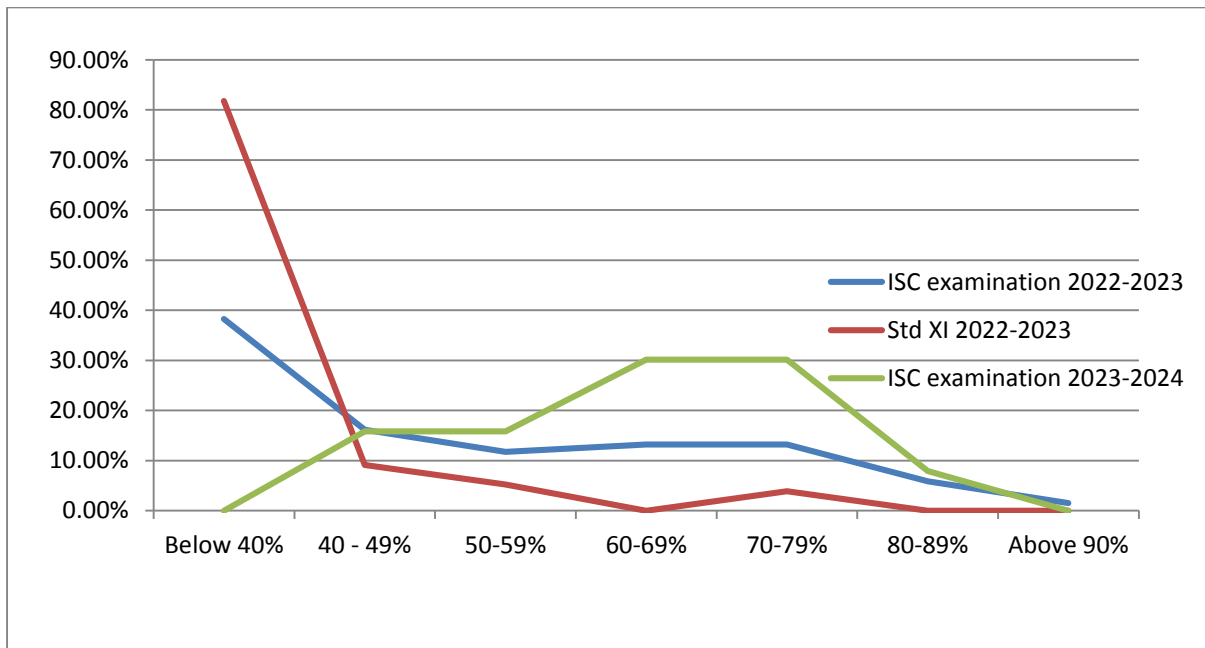
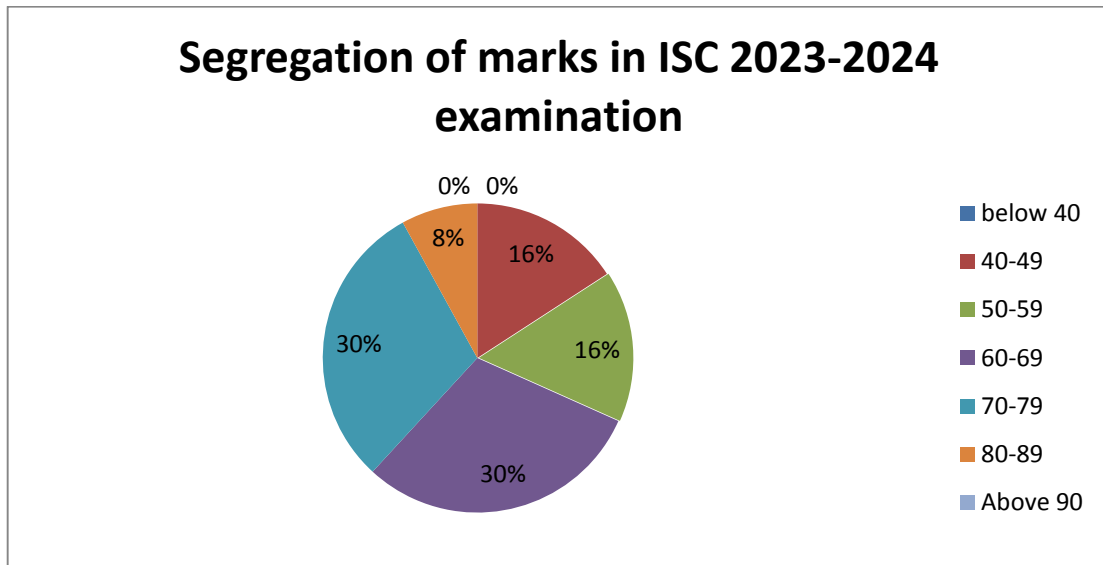


### Segregation of marks of ISC examination 2022-2023



### Segregation of marks in STD XI 2022-2023 final examination





**Analysis:** -Analysis of ISC Examination Results for 2022-2023 and 2023-2024: The analysis of the ISC examination results for the 2022-2023 and 2023-2024 batches reveals significant improvements following the implementation of targeted academic techniques. In the 2022-2023 batches, 38.23% of students scored below 40% in the ISC exam, while 81.81% performed poorly in their Std XI final term exams. However, by 2023-2024, none of the students scored below 40%, indicating the effectiveness of the interventions.

Performance in the 40–49% range remained stable, but the percentage of students scoring between 50–

59% rose from 11.76% to 15.84%. Notably, the 60–69% range saw a significant jump from 0% to 30.15%, and the 70–79% range increased substantially from 13.23% to 30.15%. While 7.92% of students scored in the 80–89% range, no students achieved above 90% in 2023-2024, down from 1.50% in the previous batch. Overall, the techniques effectively improved low and mid-range performances, though additional strategies may be required to elevate the top-performing students.

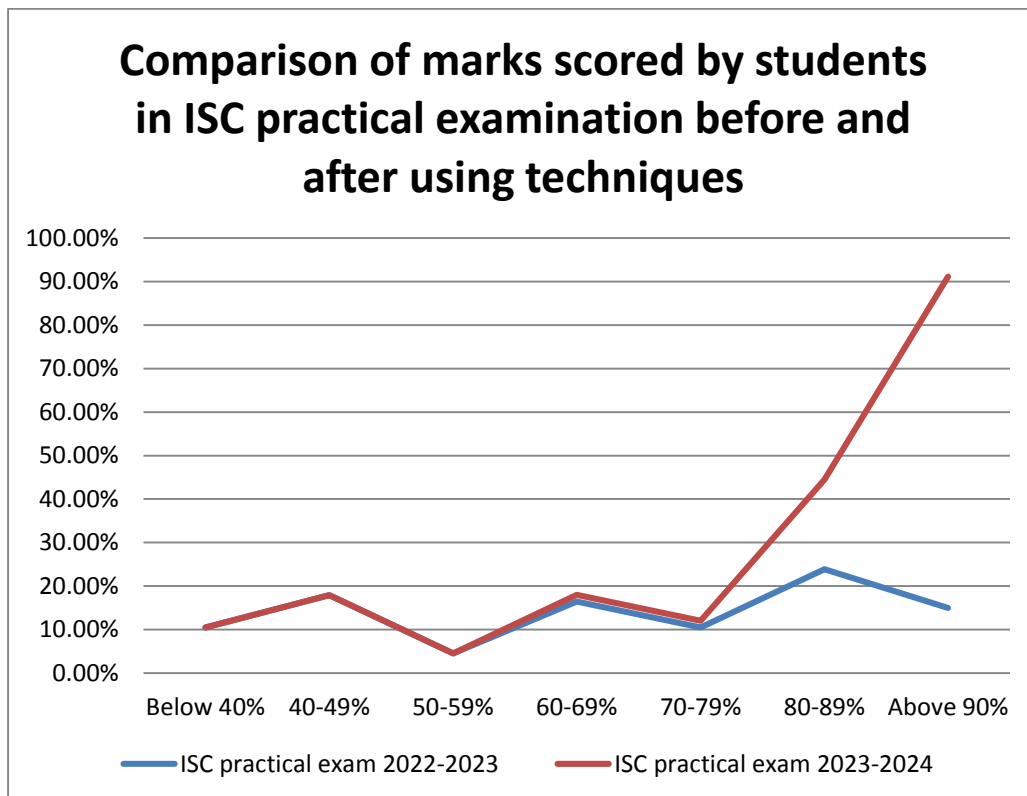
### III. Conclusion:

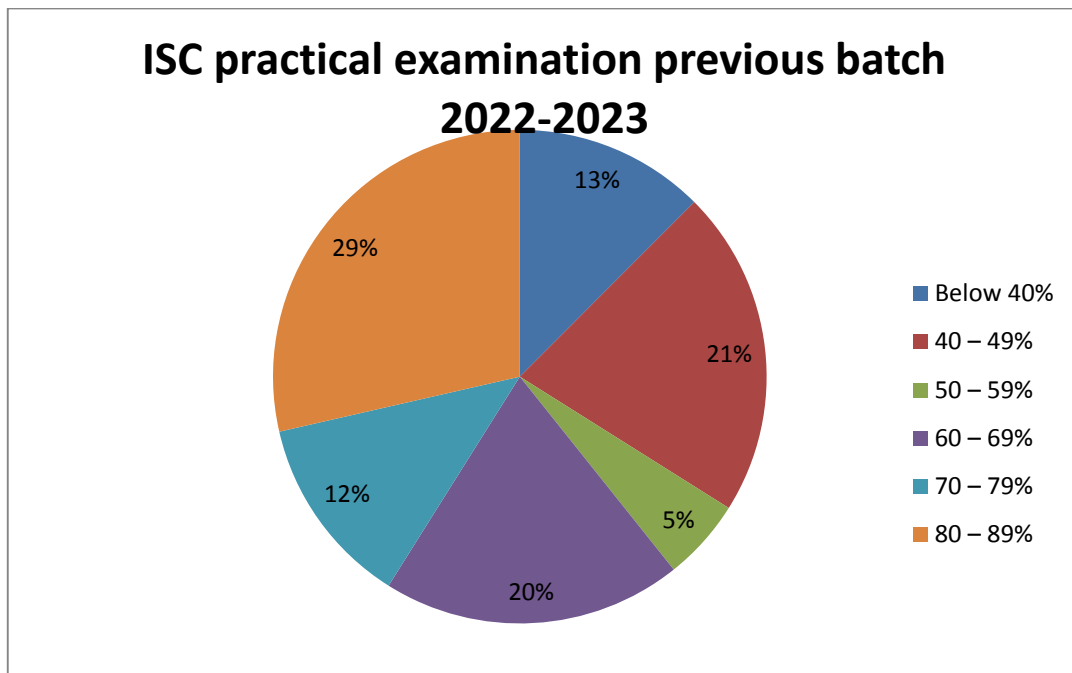
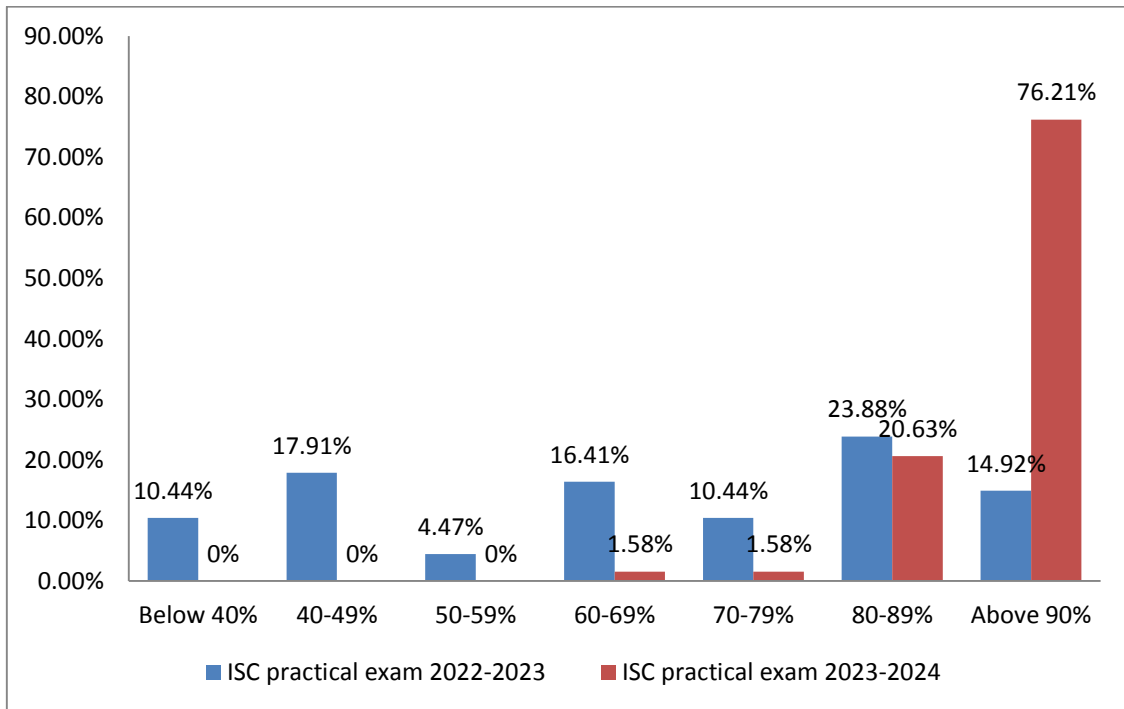


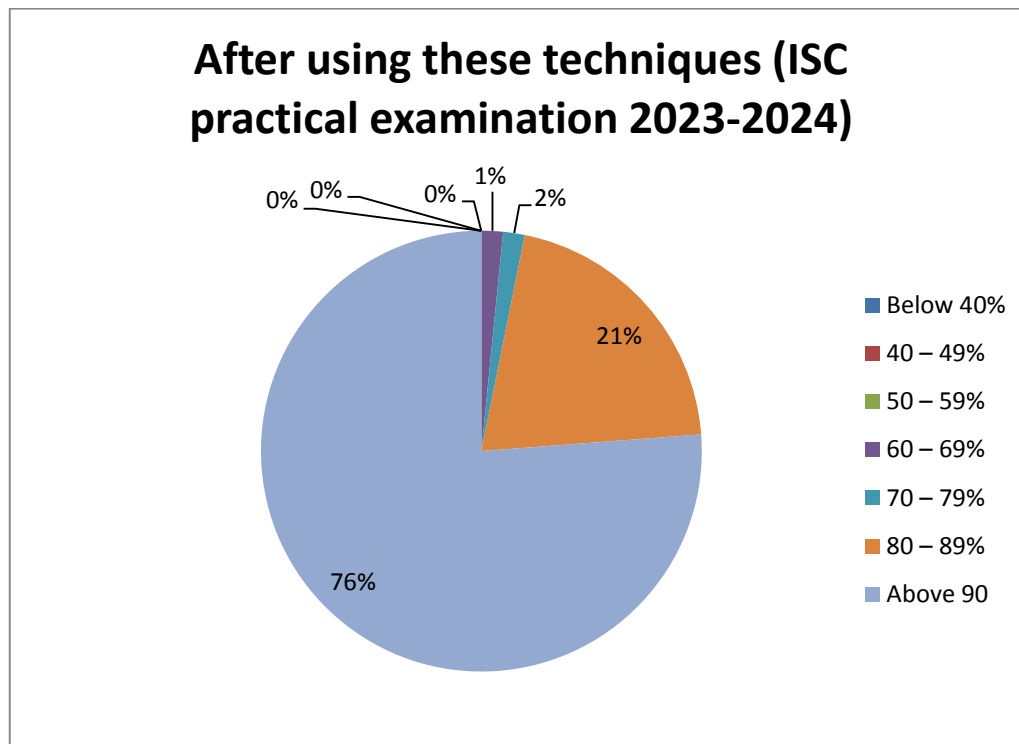
The comparative analysis shows a significant improvement in student performance in the 2023–2024 ISC batches after implementing new teaching techniques. Notably, there were no students scoring below 40%, indicating success in uplifting slow and below-average learners. Additionally, the proportion of students scoring in the 60–79% range increased, along with a modest rise in those achieving between 80–89%.

However, the techniques were less effective for high achievers, as no students scored above 90%. This suggests a need for targeted interventions to help these students excel. Overall, while the methods had a strong positive impact on improving performance across various levels, further refinement is needed to elevate above-average learners to high achievers.

Range of marks	ISC practical examination Previous batch (2022 – 2023)	After using these techniques (ISC practical examination 2023 -2024)
<b>Below 40%</b>	<b>10.44%</b>	<b>0%</b>
<b>40 – 49%</b>	<b>17.91%</b>	<b>0%</b>
<b>50 – 59%</b>	<b>4.47%</b>	<b>0%</b>
<b>60 – 69%</b>	<b>16.41%</b>	<b>1.58%</b>
<b>70 – 79%</b>	<b>10.44%</b>	<b>1.58%</b>
<b>80 – 89%</b>	<b>23.88%</b>	<b>20.63%</b>
<b>Above 90</b>	<b>14.92%</b>	<b>76.21%</b>







**Analysis of ISC Practical Examination Results for 2022-2023 and 2023-2024:** The analysis of ISC practical examination results for the 2022-2023 and 2023-2024 batches reveals significant improvements after implementing new teaching techniques. In the previous batch, 10.44% of students scored below 40%, but this dropped to 0% in 2023-2024, indicating effective support for below-average students. Similarly, there were no students scoring between 40–59%, with most moving to higher performance levels.

The percentage of students in the 60–69% range decreased from 16.41% to 1.58%, and only 1.58% scored between 70–79%. While those scoring between 80–89% slightly declined from 23.88% to 20.63%, high achievers increased dramatically, with scores above 90% rising from 14.92% to 76.21%. Overall, these results demonstrate that the new teaching methodologies significantly enhanced student performance, particularly in practical skills and academic success.

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